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GRAIN DEMAND AND CONSUMER PREFERENCES
DAKAR, SENEGAL

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Preface

This study of grain demands in Dakar, Senegal was a joint effort by the Center for Research on Economic Development (CRED), University of Michigan (Grant: US-AID/csd-2547), Purdue University (Grant: US-AID/AFR-C-1257), and Centre de Recherche Economique Appliquée (CREA).

In Dakar, the interviewers were supervised by Mr. Samba Tamsy, who also provided valuable guidance in the initial interpretation of the data.

Completion of the work in the United States was facilitated by the preparation of the data for computer analysis under the supervision of Dr. Margaret Saunders of Purdue University. David Jick from the University of Michigan was responsible for the computer analysis of the data set. Helpful suggestions were received from Professors Elliot Berg and Richard Porter (CRED, University of Michigan) and Wilford Morris (Purdue University).

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CHAPTER I

PURPOSE, METHOD, AND PLAN OF WORK

Section 1 - Purpose and Importance of This Study

This study of food grain demands by the urban population of Dakar should aid Senegalese and other developing country decision-makers in designing effective food policy. Food policy requires an understanding of the marketing habits, grain consumption and demand patterns of a country's population.

Grain imports to sustain many third world countries have led to unfavorable trade balances, hindering development efforts. Senegal, a country of 5.1 million inhabitants (1976) - 30 percent of whom are urbanized, has an agriculturally based economy. Nevertheless, nearly 30 percent of grain consumption is satisfied by commercial imports. Annual rice imports are currently 200,000 tons, costing an estimated $50 million. Most of these imports are destined for the urban population. Official Senegalese policy is to promote food self-sufficiency by increased domestic rice, millet, and maize production.

Two questions related to grain demands must be addressed. First, will the domestically produced Senegalese rice possess characteristics acceptable to the urban population? Second, will the urban population shift the composition of its grain diet towards increased millet and maize consumption? These are the two central issues on which this study focuses. Some information on the Senegalese agricultural sector follows.

Groundnuts are the primary agricultural product, with their export receipts financing the imports of rice. Millet production, due to unfavorable rainfall patterns, has been variable; a "good" year Senegal is self-sufficient in millet. Most domestic millet (perhaps 80 percent) is consumed by the rural producer whose diet, while supplemented by rice, is based on millet.

The urban Dakar consumer has a more diversified rice-based diet. Local rice accounts for only 25 percent of estimated national rice consumption, with the remainder commercially imported. As much as 50 percent of this imported rice is consumed in the Dakar/Cap Vert area.

In Senegal, attaining grain self-sufficiency primarily requires a replacement of the rice imports. A possibility would be to increase significantly local rice production; however, the domestic resource cost of this rice exceeds its current market price. Thus, economic costs to the domestic economy are associated with this alternative. Also, this local rice has characteristics differing from the imported Siam rice to which the Senegalese consumer shows a strong preference.

Another means of reducing rice imports is to increase production of millet and maize. This depends in large part upon the willingness of the Dakar consumer to accept increased quantities of these cereals. Thus, a range of policy choices exists, extending from a continuation of heavy rice imports to their replacement by domestic rice or by domestic millet and maize.

Section 2 - Method

Seventy-five households were sampled in this study, which employed three interviewers. To assure representation from all major Dakar neighborhoods, a target number of households per neighborhood was set. The interviewers then selected the households within the neighborhoods assigned to them. Such a procedure was warrented to assure that the interviewers did not know members of a household, fearing that frank responses would be comprised by any acquaintance.[1]

Initially, socio-economic information for each household was collected. Concurrently a questionnaire detailing grain purchase was initiated; the composition of meals eaten by the households was also noted. To determine the qualities of rice sought by the consumer, other questionnaires were introduced, and rice samples given to the households.

A continuing problem was the lack of previous research on grain demands in Senegal. While the IUT was an excellent source of general consumption patterns, it was not a study of individual grain demands.[2]

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[1] In fact, one household withdrew from the sample when it later became known that a relative of the household had been married to the interviewer's uncle.

[2] Institute Universitaire de Technologie; Etude: Budget Consommation: Tomes 1,2 Université de Dakar, Sénégal, Juillet 1975.

Thus, in designing this study, the literature did not provide a useful precedent. Hopefully, this research gives a profile of grain purchasing in Dakar and addresses the two important questions -- substitutability of millet for rice and preferences for rice types.

Section 3 - Plan of Work

Chapter II gives a socio-economic profile of the sample; Chapter III describes the grain purchasing and consumption patterns of the sample. Chapter IV more rigorously analyses the consumer's demand for cereals, estimating demand functions. Finally, Chapter V presents the study's conclusions, focusing on their implications for national food self-sufficiency.

CHAPTER II

PROFILE OF HOUSEHOLDS

This chapter gives a socio-economic profile of the sample households. For this study, "household" is defined to include all individuals who regularly consume their meals together, in contrast to the "nuclear" family.

Neighborhood. -- The seventy-five households were chosen from all major Dakar neighborhoods. Medina, with the heaviest concentration of middle to low-income Dakar residents contributed ten households. Eighteen other neighborhoods provided between one and five households.

Age of Head of Household. -- Consistent with the extended family concept, the mean age of the head of the household is 54.59 (Standard Deviation 12.05).

Ethnic Background. -- All important Senegalese ethnic groups were represented; the Wolof, which comprise about 40 percent of the Senegalese population, are the largest group in this sample.

Religion. -- The predominance of the households were Muslim (69) with six Christian households.

Duration of Habitation at Dakar. -- The majority of the sample (63) have been residents of Dakar for more than twenty years, with the heads of thrity households having been born in Dakar.

Origin Within Senegal. -- The largest concentration of households (33) identified their regional origin as Dakar. Others were primarily from the Fleuve and Groundnut Basin.

Average Household Size. -- The average household consisted of 11.37 (S.D. 3.14) individuals.[1,2]

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[1] Accurately measuring household size is complicated by seasonal urban-rural migration, existence of multi-household individuals, and other periodic changes in household membership.

[2] The IUT consumption study for Dakar indicated that the average family size was slightly in excess of seven individuals. The observed differential between the IUT study and this work is attributable to the definition of family/household used. While the IUT study relied on "nuclear" family units, this study employed the concept of household, as defined above. Since this study concerns grain purchases for household units, it was more appropriate to include all individuals regularly eating together within the unit studied.

The typical household was comprised of 6.33 adults (S.D. 3.35) and 5.04 children (S.D. 2.93).

Occupation. -- A relatively large number of household heads (34) were either retired or deceased. In such cases, other working members were providing household income. Those occupations for working household heads included skilled worker (11), government worker (8), commercial worker (7), and laborer (4).

Income. -- In this survey, three approaches were used to estimate income. First, monthly expenses for major consumer items were recorded. Second, the head of the household classified his income within a range of 15,000 CFA/month. Finally, the interviewer estimated the monthly household income. Considering these three estimates, the following distribution of household income was generated:

Monthly Income Head of Household	Number of Participants
0-35,000 CFA	17
35,001-65,000 CFA	33
65,000+ CFA	25
Total	75

Mean: 59,600 CFA or $248.00 (at 240 CFA/US$) S.D.: 30,655
This income is often supplemented by contributions from other household members.

Summary of Socio-Economic Profile. -- This description of the sample population has served two purposes. First, it has summarized the socio-economic composition of the sample households. Second, characteristics to be tested for their influence on grain consumption have been identified.

CHAPTER III

CONSUMER GRAIN PURCHASING AND CONSUMPTION

This chapter summarizes the mechanics of the consumer grain purchasing. The consumer's view of the marketing process and his purchasing patterns of millet, rice, and maize, are all examined. Finally, the frequency with which grain-based meals are eaten is examined.

For the purchase of grains, the consumer in Dakar has three options: first, he can purchase grain in one of the many major markets. Second, most small boutiques which saturate Dakar neighborhoods sell grains; finally, the consumer can purchase grain outside of Dakar in rural grain-producing areas.

Of the options listed above, the purchasing of grain in a major market is the most common. A wider selection of grains and types of rice is available. Second, it is more convenient to purchase major food items --- meat, fish, vegetables, grains -- in one market. Finally, there is the rational belief that a major market, attracting many suppliers and consumers, follows more competitive pricing practices.

Section 1 - Markets Used and Frequency of Use

All seventy-five households had a regular market generally chosen for its proximity to the consumer's home. The markets at Castor (24 households), Gueule Tapée (13), N'Guéla (9), and M'Babass (7) were the most frequented. The Dakar consumer made 6.6 (S.D. 2.46) visits per week to the market with the majority (60) attending the market daily.

Section 2 - Millet and Sorghum Purchasing

Most households (69) regularly purchase millet, with only two regularly purchasing sorghum. Most consumers claim that millet has a superior taste and is more nutritious than sorghum. The data collected indicate that 65 of the households purchase millet at least once a month; 42 buy millet at two-week or shorter intervals.

The following table indicates that the vast majority of consumers always purchase millet in whole grain form.

FORM OF MILLET PURCHASED

	Whole Grain	Flour	Cous-Cous
Never	19	66	63
Occasionally	3	3	5
Usually	0	1	0
Always	53	5	7

All but one of the heavy consumers of millet (those eating millet four or more times per week) always purchase millet in grain form. It is generally the occasional consumer of millet who buys cous-cous or flour. This suggests that the greater economy in purchasing grain millet outweighs the added time of preparation associated with the grain form; such a conclusion implies that programs to promote prepared millet flour or cous-cous could face consumer resistance if too large a price differential between the grain form and non-grain forms results.

Consumers generally responded that they purchased millet in grain form because it was more economical. They paid for the decortication at neighborhood machines, then transforming the flour into cous-cous themselves. The few families purchasing flour or cous-cous cited the greater ease of preparation with these forms.

Households responde[1] that their purchases varied little during the calendar year. Increased purchases during the Muslim fast month of Ramadan were cited, to prepare a nutritious and filling millet porridge. Most households purchase small quantities of millet (less than 20 kg) at a time. Only twenty-two households purchase millet in bulk form. The typical household only consumes millet about 2.5 times per week (S.D. 4.29).

Some relationship between millet consumption and origin within Senegal was observed. Families from the Fleuve and Casamance regions, two rice-growing areas, consumed slightly fewer millet-based meals per week than the sample group (2.14 vs 2.47).

The preponderance of households (70) claimed that millet was exclusively consumed in the evening. These results suggest the great difficulty in

replacing imported rice by locally grown millet. Since rice is consumed primarily at mid-day, it is questionable to what degree millet and rice are substitutable products.

Most consumers (55) did not have a regular millet seller. These households purchase millet after comparing the price and quality of the various sellers. Those claiming a regular millet seller cited personal rapport (i.e. credit availability) as their motivation for selecting the seller.

Income (5 respondents), difficulty of preparation (13) and digestibility (4) were the most commonly cited reasons for not consuming more millet; to some extent these factors can be affected by governmental policy. Most households (22) cited a preference for rice or for a diversified diet (21) as their reason for not consuming more millet. Inducing these households to consume more millet through national policy is difficult. This issue is important, since policy makers have suggested various actions aimed at increasing millet consumption, including institutionally prepared cous-cous or flour, and certain marketing reforms. A full two-thirds of the sample, however, indicated that their consumption of millet was sufficient. The tentative conclusion is that millet consumption is not primarily restrained by factors subject to policy manipulation.

In summary, the typical consumer purchases millet in grain form, in small quantities about twice per month. The ten millet meals per month typically were eaten exclusively in the evening.

Section 3 - Rice Purchasing

Rice forms the staple food grain in the typical Dakar diet, with all seventy-five households regularly purchasing rice. Most households (69) purchase rice once a month, with 11 households purchasing rice daily. The mean size of purchase per market visit was 95.47 kg (S.D. 63.50). Those purchasing rice daily are primarily poorer households, receiving a daily income from small commerce or trying to avoid waste or overconsumption.

All households indicated that their daily consumption of rice during the year was stable. Most households (61) said they usually ate rice at mid-day. This observation is a direct corollary to that found concerning millet consumption; all households eating millet (70) ate millet exclusive-

ly in the evening.

Slightly more than half the households (39) had a regular rice seller, with twenty-two citing personal rapport/credit as the reason. Only seven of the households purchased rice and millet from the same trader; generally, it was claimed that the trader did not sell both grains.

As with millet, households felt their present consumption of rice was adequate. Seventy-one claimed they had reached a saturation level with rice; only four households claimed that income constrained their rice purchases. Three of those four households had a monthly income of less than 20,000 CFA. Thus, even households with relatively low incomes (20,001-50,000 CFA/month) did not cite income as a constraining influence on rice consumption.

In Dakar, imported rice from different geographic origins is available. Local Senegalese rice is primarily producer-consumed and rarely found in Dakar market. Siam rice was preferred by the vast majority (48) of the households. Subsequently, thirty-three households admitted that they were unfamiliar with Senegalese rice.

The popularity of Siam rice was confirmed by a questionnaire asking the consumer to rank his order of purchase among four kinds of rice at varying prices.[1] The types of rice used in this experiment were Siam, Pakistan-improved, Gambian, and Pakistan-ordinary.[2] At equal prices (80 CFA/kg) the Siam was preferred by forty-seven households, followed by the Pakistan-ordinary (2). In the next round of questioning, the per-kilogram prices were changed to Siam: 90 CFA, Pakistan-improved: 85, Gambian: 80, and Pakistan-ordinary: 80. The Siam continued to be the preferred purchase for twenty-nine households. Following an additional price rise for the Siam from 90 to 95 CFA/kg (all other prices constant) an additional

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[1]The consumer was asked to estimate the habitual quantity of rice he purchased. Obviously, some consumers would be induced to purchase a smaller quantity of a preferred rice as that variety's price rose. In this case, the intensity of a consumer's preference for the Siam rice would actually be understated.

[2]The Pakistan imporved was a very clean and low-oil-consuming Pakistan variety which had been previously given to the families in a rice-testing experiment. Only fifty families participated in this questionnaire.

ten households chose a lower-priced rice. Of interest is the fact that nineteen households, or 40 percent of the sample, were willing to pay a substantial premium for the Siam rice.

This behavior appears influenced by the income of the household. The twenty-nine households choosing Siam at a 5 CFA premium had a mean monthly income of 65,000 CFA, in contrast to the 59,600 mean sample income. The mean monthly income for the nineteen households which continued to choose Siam at a 10 CFA premium was 72,632 CFA. The sensitivity of rice purchasing to income is revealed by this experiment. Not only is the quantity of rice demanded sensitive to income, but the price elasticity of each type of rice seems to vary with income level.

These results are important in two respects. First, the consumer's strong preference for the Siam rice variety and his willingness to pay a premium for that rice have been shown. Second, the local Gambiam rice, similar to rice varieties found in the Casamance, was not well appreciated. In this experiment, when price-induced switching of purchases did occur, it was generally form the Siam rice to the Pakistan-improved. Thus, rice varieties are not perfect substitutes, and replacing Siam rice by a locally grown rice would meet consumer resistance.

Exploring consumers' preferences towards rice, two attempts at determining the qualities of rice sought by the consumer were made. Those qualities considered were volume of rice after cooking, absorbtion of cooking oil, taste, time of preparation (cleaning and cooking), and the quantity of water absorbed. From direct questioning, volume and oil absorption, both directly related to the final cost of the meal, emerged as the most important characteristics.

These results were confirmed by a more rigorous goal hierarchy test which provided the following common scale ranking values.[1]

Volume	1.00
Oil Absorption	.926
Taste	.453
Preparation Time	.270
Water Absorption	0

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[1]Harman, Wyatte, "An Evaluation of Factors Affecting the Hierarchy of Multiple Goals," Oklahoma State University, Technical Bulletin T-134, June, 1972.

These two tests provided the same ranking of rice characteristics. The general consensus is that Siam rice best approaches the volume/oil requirement. Also, the Siam rice has a taste appreciated by consumers. Thus, the group's strong preference for the Siam rice is understandable.

In summary, rice is generally purchased once a month in 100-kilogram quantities, with the consumer having a habitual rice seller. All households ate rice at mid-day, many also eating rice in the evening. Volume of rice after cooking and oil absorbtion were those qualities most important to the consumer, with Siam rice best satisfying these requirements. Due to the close scrutiny given rice varities by the consumer, replacing the imported Siam rice by a local variety could meet strong consumer resistance.

Section 4: Maize Purchasing

Dakar households consume very little maize, either in grain or flour form. Forty-one households never purchase maize, and only seven claimed a weekly consumption in excess of four kilograms. Of the thirty-four households purchasing maize, thirteen purchased in grain form and twenty-one purchased maize flour. Those purchasing maize grain often grind the maize to mix with millet in cous-cous, while those purchasing flour often prepare a maize porridge.

Most households (44) said their consumption of maize was limited by their preference for rice; twenty respondents cited the difficulty in preparing maize. Households generally expressed a dislike for or an ignorance of maize-based meals. Locally grown maize has great potential, with high-yielding maize varieties having been successfully introduced in Senegal. If urban maize demand could be stimulated, a rapid supply response is possible with consequent declines in rice imports. Public policy should be aimed at educating the urban population to the various types of maize-based meals.

Section 5: Grain Consumption Patterns

The interviewers visited the households daily, recording the composition of each meal for three weeks. As the following table shows, the typical household has a rice-based meal nearly every day at noon with

little variance (coefficient of variation is .098). Mid-day millet consumption was insignificant, consumed only three times by two households during the three week period.

NUMBER OF GRAIN BASED MEALS PER WEEK[a,c]

	Millet	Rice	Total
Noon	.02 (.11)[b]	6.71 (.66)	6.73
Evening	2.06 (1.45)	1.97 (2.14)	4.03
Total	2.08	8.68	10.76

[a]Based on a three-week average.

[b]Standard deviations are in parentheses.

[c]Due to the more intensive nature of this questionning, only forty-four of the original seventy-five households were maintained in this phase of the research.

The typical household consumed two millet-based meals per week in the evening. Rice competed with millet in the evening with a mean of 1.97 rice-based evening meals. On average the household consumed grains at 10.76 meals per week, of which 8.68 or 80 percent involved rice.

Within this rice-based diet, 6.71 of the 8.68 (77 percent) weekly rice meals are consumed at noon, suggesting that at least 77 percent of all rice consumed in Dakar is prepared at mid-day. These noon meals of fish and rice are more rice-concentrated than evening rice meals. Thus, food self-sufficiency requires replacing imported rice at noon. As the frequency of millet in noon meals indicates, millet may not be a viable alternative to rice at mid-day.[1]

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[1]These results are supported by a survey of meals eaten by the rural population of the Sine-Saloum in Senegal. Nearly 85 percent of all rice meals were eaten at noon. Millet meals predominated in the evening, with 96 percent of all cous-cous consumed in the evening. Thus, even in a millet dominant region, the relative heaviness of cous-cous restricts its consumption to evening meals. (See: Yaciuk, G. and A.D., "Discussions des Resultats de l'Enquête sur la Technologie Post-Recolte en Milieu Paysan Au Sénégal." November 1977, pp. 51-52.)

In the evening, some limited possibility for substituting millet for rice does exist. For instance, inducing households to substitute one evening meal for a rice meal per week would reduce the typical household's annual rice consumption by about 135 kilograms.[1] Thus, a 50 percent increase in the frequency of millet-based meals from 2.08 to 3.08 per week would only replace 6,000 tons of imported rice, or about 3 percent of current Senegalese rice imports.

This chapter has shown that the question of grain self-sufficiency for Senegal is complicated. First, the degree of substitutability between rice and millet is not clear. Second, the degree of substitutability between the preferred Siam rice and locally grown rices of differing characteristics is also debatable. The next chapter attempts to derive empirical estimates of the consumers' grain demand functions.

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[1]Annual rice consumption is 1,174.5 kg (see Chapter IV) per household. Reducing total rice meals from 8.68 to 7.68 per week would imply a maximum annual savings of 135 kg of rice per household. This amounts to 6,000 tons for Dakar's population of 500,000.

CHAPTER IV

ANALYSIS OF CONSUMER GRAIN DEMAND

This chapter endeavors to estimate urban grain demand functions using the survey data. The first section of this chapter analyzes total grain consumption, and the second, third, and fourth sections concern individual grains -- millet, rice, and maize, respectively. The empirical results presented here are indicative and should be treated as complementary information to the descriptive material presented in Chapter III. Small sample size and measurement error reduce the confidence which can be placed in the coefficients. Nevertheless, the overall consistency of the results presented in Chapters III and IV help justify the major conclusions.

Section 1: Total Grain Consumption

Various nutritionists place the desired annual per capita milled grain consumption in Senegal at 182.5 kg.[1] Since that standard is rather arbitrary, its use here is only as a reference point. For sixty-two of the seventy-five households followed, the following summary statistics were calculated.[2]

ANNUAL PER CAPITA GRAIN CONSUMPTION (KG) AND EXPENDITURE (CFA)

	Millet[a]	Rice	Maize	Total
Consumption	65.0	103.3	6.4	174.8
Standard Deviation	(20.4)	(27.4)	(18.0)	(37.29)
Percentage	37.2	59.1	3.7	100
Expenditure[b]	3,900	8,264	384	12,548

[a]This includes whole grain, millet flour, and cous-cous. Approximately 95 percent of the weight is whole grain.

[b]Prices of 60, 80, and 60 CFA/kg were used for millet, rice, and maize, respectively.

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[1]This standard has been accepted by the Gambia Basin Study Commission for planning purposes.

[2]Thirteen households were excluded because of incomplete or conflicting data elements. The annual estimates were calculated using data collected during three months.

Estimated per capita grain consumption was only slightly below the 182.5 kg consumption standard. The table shows the dominant share of rice in total grain consumption.

The coefficient of variation is higher for millet than for rice. This is consistent with the belief that rice consumption by Dakar households is relatively invariant to socio-economic influences. The rather insignificant level of maize consumption should be noted. Finally, the mean monthly grain expenditure per household of 11,889 CFA ($54) represents 20 percent of mean monthly income (59,600 CFA).

The variability of grain consumption to key socio-economic indicators is now investigated.

Income Per Household. -- The correlation between income and total per capita grain consumption was insignificant. Tests for relationships between the individual grains and income revealed a significant negative correlation between per capita millet consumption and income. No relationships between income and per capita rice or maize consumption were significant.

Size of Household. --Individual grain demands are positively influenced by household size; however, the magnitude of this influence declines with household size (i.e. a quadratic relationship). The correlations between household size and millet, rice and total grain consumption were all negative and significant. These relationships could be explained in a number of ways. First, larger households may have a greater percentage of children, whose grain consumption is less than that of adults. However, for this sample the correlation between household size and the number of children was not significant, reducing the validity of this explanation. Second, there may be some "economies of scale" in preparing grain-based meals. Smaller households may be required to produce greater quantities of fish/rice or cous-cous than desired, with waste, neighborhood sharing, or reheating occurring. In the later two cases, estimated per capita consumption would be biased.

Finally, there is a tendency for households to purchase fixed amounts of cereals, like a 100 kg sac of rice each month, without complete regard for household size or needs. Consequently, in a larger household the per capita ration of rice would be less than that of a smaller household.

While the data do not permit a resolution of this question, it is important to emphasize that the composititon of the household may be a significant element in overall grain demands. Structural shifts in household size may then affect grain demands. Since a per capita planning concept would tend to camouflage such changes in demand, effective planning should consider household size.

Ethnicity. -- No relationship between ethnicity and per capita grain consumption was found.

Length of Time at Dakar. -- No significant relationship between grain consumption and length of time at Dakar was found. It appears that newer residents adopt the prevailing urban consumption habits upon arriving in Dakar.

Section 2: Millet Demand

In this section, millet consumption (estimated at 65 kg annually per capita) will be discussed in greater detail. In the previous section, all millet forms were aggregated. For further analysis the millet form should be identified and isolated. Of the millet purchased during the survey period, 95 percent was whole grain; consequently, this section discusses demand for whole grain millet, netting out purchases of flour and cous-cous.

An important question is the extent to which the estimates of income and price elasticity for whole grain millet apply to cous-cous. Since the vast majority of consumers cited the reduced cost involved in self-transforming millet, the differential cost of an institutionally prepared cous-cous over the grain form must be known before projecting the demand for prepared cous-cous. At some per-kilogram price differential (10 CFA/kg for direct milling costs plus a premium for labor/inconvenience) the consumer would be indifferent in deciding whether to purchase whole grain or prepared cous-cous. Were the price differential less than the above differential, millet consumption would be stimulated; a greater price differential would leave purchases unchanged, ceteris paribus, as consumers would continue to purchase the grain form. In summary, the results presented for whole grain milled would generally be applicable for a prepared cous-cous which had a price differential similar to the

costs now paid by the consumer in self-transforming millet.

Demand Estimates

Both a simple linear demand relationship and a double logarithmic demand function were estimated.[1] In both cases monthly household millet consumption (mean 61.7 kg) was the dependent variable. The independent variables were household income, price of millet, and the number of adults and children in the household. The estimated equations are presented on the following page.

In both specifications the size of the household is significant. The linear specification suggests that an additional 3.4 kg per month are purchased for each additional household member.[2] The demand response is slightly higher for adults than for children.

The price response and implied price elasticities for millet are quite high, but with very large standard errors. One interpretation of this is that a high price elasticity is possible since millet is consumed almost exclusively in the evening. A wide range of substitute products could be used at this meal. Were the price response this high, millet consumption could perhaps be greatly increased with either technological progress in agriculture or with millet price reductions through national policy. This may be true, but it would only decrease rice imports to the extent that rice is consumed in the evening.[3] As rice is generally consumed at noon and millet exclusively consumed in the evening, the degree of substitutability between the two grains is somewhat limited. Since there are other substitutes for millet in the evening, an increase in millet consumption does not necessarily imply

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[1]The fundamental difference between these two specifications is that the double logarithmic function implies a constant elasticity for an independent variable, but a marginal effect varying with the level of other independent variables.

[2]The point elasticity at the mean for household size is .47.

[3]Due to the constancy of the rice price, it is impossible to estimate the rice cross-price elasticity for millet.

MILLET DEMAND

Variables	Const.	PM	I	N	A	C	F	R^2	SE
Linear I	100.1	-1.25	.00002	3.44			12.81	.40	20.12
	(2.05)	(-1.60)	(.29)	(5.93)			(99.9)		
Linear II	99.3	-1.25	.00003		3.68	3.16	9.51	.40	20.27
	(2.02)	(-1.58)	(.35)		(4.39)	(3.46)	(99.9)		
Logarithmic I	7.81	-1.13	-.05	.617			10.53	.36	.318
	(2.40)	(-1.45)	(-.65)	(5.33)			(99.9)		
Logarithmic II	7.67	-.994	-.41		.37	.20	7.27	.35	.326
	(2.27)	(-1.23)	(-.50)		(4.45)	(2.82)	(99.9)		

61 observations for each equation.

(1) where PM = Price of millet (CFA/kg)
I = Income (monthly household in CFA)
N = Number in household
C = Number of children
A = Number of Adults

(2) T Statistics are in parentheses for the independent variables.

(3) For the F statistic the level of significance is shown in parentheses.

an equal decrease in rice consumption.

The income effect does not significantly differ from zero in any equation. The simple correlation between monthly income and household purchases was also insignificant. Since only five of the seventy-five households cited income as a constraint to consuming more millet (Chapter III, Section 2), income had not been perceived as a major influence on millet purchasing. In contrast, per capita millet consumption was negatively correlated with income. The resolution of this paradox is that by being negatively correlated with household size, per capita millet consumption is spuriously correlated (negatively) with income because of the weak but positive correlation between income and household size.

Two policy implications emerge from this discussion. First, while the relatively strong price response for millet suggests the possibility of using price policy to stimulate millet consumption, increased millet consumption would not necessarily decrease rice consumption. Second, this price response suggests that introducing an institutionally prepared cous-cous which implies a higher cost for a millet-based meal would meet consumer resistance.

Section 3: Rice Demand

Annual rice consumption, estimated at 103 kg per capita, accounts for approximately 60 percent of the consumer's grain intake. The per capita variance of this rice consumption, as measured by the coefficient of variation (.27), is relatively small. Before presenting the demand results it should be noted that rice is sold at a controlled price (80 CFA/kg). This complicates testing the relationship between price and demand, since there is no variation in the rice price. Further, rice demand should be disaggregated by the various types of imported rice with cross-price terms for other rice varieties included in separate rice demand functions. Neither the sample size nor the availability of data permitted such a specification. Critical price levels at which variety switching occurs were discussed in Chapter III.

Demand Estimates

The dependent variable was monthly household rice consumption

(Mean 97.88 kg) with income and household size the independent variables. These estimated equations are given on the following page.

The derived income elasticities are quite low; for the linear specification the income elasticity at the mean is only .12. Rice had generally been assumed relatively income inelastic, since only four households cited income as a constraint to rice consumption.

Household size is the major influence in both demand specifications. The marginal impact of an additional adult slightly exceeds that of an additional child in both equations. These household size variables slightly exceed their analogues in the millet demand equations, consistent with the larger per capita rice consumption.

The lack of information regarding the price responsiveness of rice demand and the relationships among price and rice types is regrettable. The indication from Chapter III is that Siam rice is more price inelastic than other rice varieties. In conclusion, the typical household's demand for rice is primarily a function of household size. The combination of taste/habit for rice and the relative inexpensiveness of the fish/rice mid-day meal maintains a household rice demand little influenced by other factors.

Section 4: Maize Demand

Due to the paucity of households purchasing maize, few statements about maize demand can be advanced. While only eight of the sixty-two households purchased maize during the survey period, their mean monthly household consumption was important, 66.5 kg (S.D. 44.51) This represents an annual per capita consumption of 48.62 kg for these households.

Of interest is the fragmentation of households into those consuming important quantities of maize (8) and those never purchasing maize (54). The reason for this sharp division probably revolves around habit and awareness. Of importance is the fact that maize, more than millet, could be substituted for imported rice. From the demand perspective maize could have greater acceptability than millet, since maize can be ground in a fashion similar to broken rice and consumed at noon with fish. From the supply perspective, replacing rice imports by domestic maize production would be more easily accomplished than by either domestic rice or millet. If maize demand is constrained by families' being unaware of

RICE DEMAND

Variables	Const.	I	N	A	C	F	R^2	SE
Linear I	39.51	.0002	4.11			17.44	.37	26.73
	(3.64)	(1.79)	(5.34)			(99.99)		
Linear II	38.70	.0002		4.61	3.54	11.63	.38	26.87
	(3.52)	(1.86)		(4.14)	(2.92)	(99.99)		
Logarithmic I	2.74	.07	.55			26.49	.48	.24
	(4.19)	(1.20)	(6.39)			(99.99)		
Logarithmic II	3.00	.06		.36	.18	18.37	.50	.24
	(4.99)	(1.04)		(5.97)	(3.41)	(99.99)		

61 observations for each equation.

(1) where I = Income (CFA/Month)
N = Number in Household
A = Number of Adults
C = Number of Children

(2) T Statistics are in parentheses for the independent variables.

(3) For the F statistic the level of significance is shown in parentheses.

of the many possible ways to prepare maize, some initiative to demonstrate interesting maize meals is needed. If, however, maize consumption is restrained by an absolute preference for rice, the promotion of maize is more complicated.

Section 5: Major Findings

The typical Dakar household is an important consumer of grains, particularly rice. Annual per capita grain consumption was estimated at 174.8 kg. On the household level, grain demands were strongly influenced by the size and composition of the hosuehold, with adults having the larger marginal impact. Income seems to influence rice consumption, but the derived elasticities were very low. Millet consumption appears invariant with income. The influence of own price was strongest on millet, perhaps explained by millet's being exclusively consumed in the evening, when a broad range of substitutes is available. This point is relevant to programs aimed at introducing an institutionally prepared cous-cous. The stimulus from reduced preparation time could be more than offset by a higher price, with millet consumption actually falling.

Another important price issue concerns the consumer's strong preference for the Siam rice variety. The sample group's willingness to pay a premium for the Siam variety shows the difficulty in replacing imported rice by domestic rice. The possibility of greater maize consumption, particularly as a substitute for rice at noon, cannot be completely discounted by the results of this research.

The above findings must be weighed in light of the small sample size and the relatively short time period upon which these results are based. Also, the absence of any price variation for rice can lead to misspecification and biased coefficients. Nevertheless, confidence can be placed in these findings for several reasons. First, the major consumption trends indicated by the data are consistent with observed behavior in Dakar. Second, the data set appears internally consistent. Responses to the introductory questions about general purchasing behavior

are consistent with the recorded purchases. Finally, the findings are comparable to those in the IUT study of household budgets.[1] The concluding chapter discusses the implications of these results for food self-sufficiency in Senegal.

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[1] Institut Universitaire de Technologie, Etude: Budget Consommation, Dakar, July 1975. The IUT study indicates a per capita monthly grain expenditure of 1226 CFA compared to 1046 CFA in this study. The IUT study used "consumption units" which effectively reduced household size, since children were weighed less than adults. This partially accounts for the higher per capita IUT estimate.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This chapter examines Senegal's professed goal of food self-sufficiency in light of this study's main conclusions. Essentially, the food self-sufficiency strategy implies increasing domestic production of rice, millet, and maize, as well as shifting the composition of grain consumption towards more millet and maize, with less reliance on rice.[1] Thus, both grain demand and supply components are addressed in this strategy.

Rice production increases could technically be achieved; however, the final market price of that rice, assuming no subsidy element, could exceed 120 CFA/kg. Such a consumer rice price (50 percent higher than the current price) would undoubtedly lead to urban discontent. Significantly increasing domestic maize production is also feasible. Both under-utilized lands in Senegal-Oriental as well as planned irrigation projects from Senegalese rivers hold great potential for maize cultivation.

The results of this study are more relevant to the government consumption targets. First, the targeted 43 percent reduction in rice consumption by 1985 would imply a decrease in annual per capita rice consumption from 103.3 kg to less than 60 kg in Dakar. Based on the demand patterns shown in this study, that goal is unrealistic. The section on grain meals eaten indicated that about 80 percent of all rice is consumed at mid-day. Millet does not appear acceptable as a mid-day substitute due to its incompatibility with fish and its heaviness. Maize has long-term potential, since it can substitute for rice in the traditional fish/rice dish. Thus, a significant reduction in rice consumption is unlikely in the immediate future.

A related point to the rice consumption concerns the planned increase in domestic rice production. Even if the cost-price issue were resolved, there is still the question of consumer willingness to substitute a domestic rice for the currently imported Siam broken rice

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[1] Government of Senegal, Food Investment Strategy, Dakar Senegal February 1977, pp. 5-19.

for which there is strong consumer preference. Limiting imports of Siam rice as domestic rice production increases could simply lead to black market rationing of Siam rice, with adverse efficiency and equity effects.

The planned maize consumption increase form 82,000 tons to 170,000 tons by 1985 is ambitious. Undoubtedly, sharply increased maize consumption is possible, but only in the long term, after extensive promotional efforts.

The projected millet flour consumption increase implies a per capita consumption increase of only 12 kg/year. This is reasonable, but two cautions must be addressed. First, the increased milled consumption, undoubtedly in the evening, could be at the expense of other foods beside rice. Second, since millet appears to be quite price elastic, the additional per capita millet consumption cannot be expected if flour processing costs greatly increase the consumer millet price. It may be more prudent for the government to devote its efforts to millet production programs, allowing the consumer to transform the grain to flour himself.

The results of this Dakar consumption study are not entirely supportive of the government's food self-sufficiency strategy. The most critical conclusion is that sharply decreased rice consumption would be difficult to achieve in the short run. In general, this study has addressed the two major issues concerning food self-sufficiency and the urban consumer; the question of substitutability between rice and millet or maize has been examined. Second, the difficulties with replacing Siam rice by a locally grown rice of differing characteristics have been discussed. Continued consideration of these issues is required to design an effective food policy for Senegal.

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